

**African Trombiculidae (Acarina). 1.
An Interim Note on the Genus *Trombicula* Berlese
and the Subgenus *Microtrombicula* Ewing.**

By

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The preparation of the trombiculid section of the checklist of ectoparasites of vertebrates of Africa south of the Sahara (Zumpt, 1959) has made it necessary to clarify the relationships of certain genera, two of which have become very heterogeneous because of uncertainty about the true relationships of the type species: these two genera are *Trombicula* Berlese and *Euschongastia* Ewing. The object of the present note is to clarify the present position regarding *Trombicula* and the many species and various subgenera which have been placed in it. This clarification, necessary in the interests of the checklist, is however only a temporary expedient, because a good deal of work still remains to be done in sorting out a number of species and in seeing what guidance can be given from studies of postlarval stages. One of us (P. H. V.-G.) is engaged on a detailed survey of the larvæ which however will not be completed before the checklist must go to press. Meanwhile, some further preliminary sorting out is being published: in a sister paper to the present one (Audy and Vercammen-Grandjean, 1959) on *Eutrombicula*; another by Audy (1959) on *Leptotrombidium* Nagayo *et al.*; and by Audy and Domrow (1957, 1959) on *Euschongastia* in the Oriental and Australasian regions.

The various revisions now in progress take into account the larval characters noted by Vercammen-Grandjean (1956*b*, *c*), and Vercammen-Grandjean and Audy (1956), and also studies of postlarval stages by Crossley (1958), Domrow, Manabu Sasa, and ourselves.

Genus Trombicula Berlese, *sensu stricto*

Type species: *Trombicula minor* Berlese, 1905.²

Trombicula Berlese, 1905, Redia, 2: 154; Gunther, 1951, Proc. Linn. Soc. N.S.W., 76: 66-70 (on the generic type); Womersley, 1952, Rec. S. Aust. Mus., 10: 31 (in part); Fuller, 1952, Zool. Verh., 18: 15-96, 251 (detailed documentation); Wharton and Fuller, 1952, Mem. Ent. Soc. Wash., 4: 41 (world checklist); Audy, 1954, Stud. Inst. Med. Res. Malaya, 26:

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² The *T. minor* of Gunther and other authors, proposed as a vector of scrub-typhus in New Guinea and Queensland but later shown not to be a vector, was a misidentification for *Eutrombicula wichmanni* (Ouds.), which causes scrub-itch. Gunther (1951) clarified this incorrect determination.

137 (discussion taxonomy); Domrow, 1957, *idem*, 28: 113-120 (nymphs); Womersley and Audy, 1957, *idem*, 28: 246, 254 (emendation of Womersley, 1952); Audy, 1959, *Med. J. Malaya* (restriction; tabulated).

Microthrombidium Oudemans, 1912 (*not* of Haller, 1882), *Zool. Jb. Suppl.*, 14: 5 (in part).

Otonyssus Kolnati, 1856, "Die Parasiten der Chiroptern", as emended by Oudemans, 1937, *Kritisch Historisch Overzicht der Acarologie*, 3D: 1362 (synonym of *Microthrombidium* Oudemans and *Trombicula* Berlese).

Microtrombicula Ewing, 1950, *Proc. Ent. Soc. Wash.*, 52: 297 (originally as a subgenus of *Eutrombicula*).

Discussion.—The generic type, *T. minor*, is known only from incomplete descriptions and drawings of very small adults collected from bat-guano from a cave in Java. They were redescribed by Willmann (1941) at a time when taxonomic characters of the post-larval stages were little understood. The type specimens were destroyed during the bombing of Hamburg in World War II. Gunther (1951) summarized all that was known of this species at the time, and Wharton and Fuller (1952) in their monograph and checklist of world chiggers pointed out that the genus *Trombicula* must either be considered as containing the type species alone, until such time as more typical material is found, or that a sort of truce may be declared by accepting the many later subdivisions of this genus as subgenera, in the interests of stability. Two later events bear on this important question of stability: (a) it has been learnt by correspondence that the original type-locality caves have been despoiled and there appears to be no chance whatever of collecting more material from there¹; and (b) studies of bat-chiggers in the neighbouring country of Malaya have made it clear that *T. minor* is congeneric with either of two species-groups now known in both larval and post-larval stages, *viz.* almost certainly the "NOR" group (species as yet undescribed), and just possibly the *panieri*-group, discussed below. It is therefore now possible to clarify the relationships of the genus *Trombicula* although the generic type will for ever remain doubtfully identifiable.

It is our considered opinion that *T. minor* is identical with, or at least congeneric with, a Malayan species of bat-chigger with the code-name "NOR" (No. 6 in list of Audy, 1956b, shown as larva and nymph in fig. 2C, D in Audy, 1954, p. 139), shortly to be described. This species represents a group of three species, yet undescribed. Closely related to this group but clearly distinct from it is the large *panieri*-group of Audy (1954, p. 147), which can now be equated with *Microtrombicula* Ewing, here recognized as a subgenus of *Trombicula*. This subgenus is being reviewed in detail, with descriptions of a number of new larvæ and nymphs, by one of us (P. H. V.-G.). It is much better developed, especially among bats, in Africa than in Malaysia. *Trombicula batui* Phillip and Traub (1950) is the commonest member of this group on Malayan bats, and the authors suggested that it or a closely related chigger might be *T. minor* because it was a bat-chigger from the same zoogeographic

¹ Moreover, in our experience the pattern of infestation of bats in caves may change with time and circumstance and season, so that there would be no guarantee that any tiny adults now found in the type locality must need be *T. minor*; nor could it be assumed that larvæ found on some bats must be the same species as adults found in the guano.

region and was also small. Several different groups of bat-chiggers are however very small. Nymphs of *T. batui* have not yet been reared but the nymphs of this subgenus have been well studied (Malayan species *T. munda* by Domrow, 1957 ; several African species by P. H. V.-G.), while the subgenus has its main centre of development in the Ethiopian region.

The genus *Trombicula* has been dealt with in several different ways since World War II. This has led to complications which can be clarified only by tabulating equivalent taxons of various authors, and this has been done for all then-known genera by Audy (1954, p. 134) and for taxons artificially or genuinely related to *Trombicula* by Audy (1959). We may here note the following briefly: (1) Wharton and Fuller (1952) in their checklist of world chiggers split the genus into eight subgenera, all of which were clearly defined except the subgenus *Trombicula*, which was used to accommodate the many species which could not be accommodated elsewhere. Their subgenus *Trombicula* was thus a provisional mixed group awaiting sorting, although Fuller (1952) was not in favour of using the subgenus thus. (2) Womersley (1952) in his monograph attempted to use both larval and postlarval characters in his system. He considered that the original drawings of *T. minor* adults showed the presence of parasensillary eyes, and he therefore accommodated the species which we now know to be *Eutrombicula* in his concept of the subgenus *Trombicula*. This led to repercussions in the whole heterogeneous genus which were rectified later (Womersley and Audy, 1957), when 5 subgenera were recognized together with a group of unallocated species. (3) Radford (1954) in his checklist of world chiggers unfortunately raised all Womersley's subgenera to genera, giving new combinations (unannounced) to very many provisionally allocated species. Although it is now impracticable to attempt disentangling this list, a guide may be found in two tabulations, already noted, of equivalent taxons. (4) Audy (1954) in a provisional revision of the trombiculids, restricted the subgenus *Trombicula* approximately to what we are now regarding as the genus, preferring to leave all the species of uncertain status unallocated to any subgenus—many of these species he placed in provisional species-groups, a number of which have since been made subgenera or genera, e.g. *Babiangia* Southcott, *Toritrombicula* Sasa (= *Vorcana* Audy, syn.: Audy, 1959), *Siseca* Audy. (5) Audy (1957) in a checklist of chiggers of the Oriental and Australasian regions attempted to bring the existing lists up to date and to provide cross-references to the various monographs and earlier lists. His arrangement of genera and subgenera was necessarily conservative.

Revised diagnosis, sensu stricto.—For the present purpose we propose restricting the genus *Trombicula* to trombiculides of which the larvæ have either 5 or 6 barbed setæ to the palpal tarsus (tentacular formula 5B or 6B), unexpanded and often very simply branched sensillæ, scuta either subpentagonal or with sinuous posterior margin, and anterior margin typically without, but in other groups with, anterolateral "shoulders" (extension anterior to the antero-

lateral setal bases). The genus as here envisaged comprises two subgenera (*Trombicula*, *Microtrombicula*), and two species-groups (*mastomyia*- and *ugandæ*-groups) to be revised as subgenera later (P. H. V.-G. in Ms). In addition, there must be included a miscellaneous collection of species awaiting allocation: it is not feasible to place these latter species with confidence at present, but they should certainly not be accommodated in any of the recognized subgenera or species-groups unless their relationships clearly indicate this.

Subgenus *Trombicula* Berlese, *sensu stricto*

Type species: *Trombicula minor* Berlese, 1905.

It is assumed that this subgenus is identical with the "NOR" group of Malaysian bat-chiggers (NOR: first three letters of an anagram of *minor*). It is characterized by the following: the tentacular formula is 5B, there are 3 genualæ-I, there is no mastitarsala-III, eyes are present (1 + 1, perhaps 2 + 2), the galeal setæ may be barbed or nude, the scutum has an evenly rounded posterior margin and is not deep, the anterolateral scutal shoulders are absent (AM seta roughly in line with AL setæ), and the scutum itself is verrucose or almost reticulate. The sensillæ are barbed (in *Microtrombicula* and the *mastomyia*-group the sensillæ are simple or simply branched).

There are at present no known members of this subgenus in the Ethiopian region.

Subgenus *Microtrombicula* Ewing.

Type species: *Microthrombidium minutissimum* Oudemans, 1910.

Microtrombicula Ewing, 1950, Proc. Ent. Soc. Wash., 52: 297.

This is the *panieri*-group plus part of the *spicea*-group of Audy (1954, p. 149). When this group was first named (for species *cynictia*, *panieri*, *rodhaini*, but also *giroudi* which is, however, distinct), the probable relationship to it of *Microthrombidium minutissimum* was noted. Specimens of this species have since been studied by one of us (P. H. V.-G.) and it is possible to place it firmly in this group although it is somewhat atypical and not a representative of choice. It was, however, selected by Ewing as the type and only included species of *Microtrombicula*, a new subgenus of *Eutrombicula*. The *panieri*-group must therefore be equated with *Microtrombicula*, according to the international conventions of zoological nomenclature.

This subgenus is distinguished by the following combination of characters: the tentacular formula is 6B and sometimes 6BS (*i.e.* there may in addition to the 6 barbed setæ on the palpal tarsus also be a subterminala, as in the Malayan *T. batui*); there are 2 (but sometimes 3) genualæ-I, a mastitarsala-III is exceptionally present, and there are 2 (sometimes 3) prongs to the palpal claws, eyes are present (2 + 2), the galeal seta is nude, the scutum has distinct

anterolateral shoulders (AM seta is anterior to AL setæ), it is typically bluntly subpentagonal, and the surface is frequently verrucose. The femora of the legs, especially of legs II and III, may be partly fused or even completely fused, reducing the number of leg segments to 6—this character is not shared by the other groups in *Trombicula*. The sensillæ are either simply setiform or are very simply branched (not barbed), bifurcate or occasionally trifurcate, while the proximal half of the shaft is nude. The hosts are mostly bats. The nymphs are at present indistinguishable from those of *Ascoschongastia* Ewing, characteristic features being a uniformity of body setæ; the absence of a precoxal complex; the presence of strongly barbed sensillæ, usually with thickened shafts having barbs or spicules extending down to the bases; and the presence of a pair of parascutal setæ which are always obviously longer than the others (these setæ are closest to the angle of crista and sensillary area) (Domrow, 1957*a, b*). There are 8 (4 pairs) of galeal (nude hypodermal) setæ, but this number is characteristic of many different nymphs. The larvæ of *Microtrombicula* differ from those of *Ascoschongastia* in only one obvious feature: the presence of simple unexpanded instead of expanded sensillæ. These two genera are on every score phylogenetically more closely related to each other than are most of the other groups now included in *Trombicula*, an anomaly which will in due course require resolution. In Malaysia, *Ascoschongastia* (including *Laurentella* Audy) pertains particularly to arboreal rodents (Audy, 1956).

This is a large group best developed in Africa but also encountered in the Oriental and Australasian regions. In Africa, where a number of new species are being described in a paper in preparation, the hosts are mostly bats. In Malaysia, there are relatively few species and their hosts are both bats and arboreal mammals: *T. munda* Gater has an interesting discontinuous distribution, occurring on arboreal rodents and also on the Malayan House-rat (*Rattus r. diadrii*) in towns. Exactly the same distribution is shown by *Ascoschongastia indica* (Hirst) which occurs on tree-rats and tree-squirrels in the forest edge, in oil-palm estates, and then again on house-rats.

The following six Ethiopian species are here placed in the subgenus *Microtrombicula*; all of them except for *T. minutissimum* for the first time. Over 12 more species are being described. The original combination, and the combination used in the checklist of Wharton and Fuller (W. and F., 1952) are alone given here.

Trombicula (Microtrombicula) cynictia Radford.

Trombicula cynictia Radford, 1942, Parasitology, **34**: 62.

Trombicula (Trombicula) cynictia W. and F., 1952: 64.

Trombicula (Microtrombicula) jadini (Vercammen-Grandjean).

Eutrombicula Jadini Vercammen-Grandjean, 1952, Ann. Soc. belge Med. trop., **32**: 645.

Trombicula (Microtrombicula) minutissima (Oudemans).*Microthrombidium minutissimum* Oudemans, 1910, Ent. Ber. Amst., 3 : 104.*Trombicula (Eutrombicula) minutissima* W. and F., 1952 : 49.*Trombicula (Microtrombicula) nycteris* Jadin *et al.**Trombicula nycteris* Jadin, Vercammen-Grandjean and Fain, 1955, Rev. Zool. Bot. Afr., 52 : 249.*Trombicula (Microtrombicula) panieri* Jadin and Vercammen-Grandjean.*Trombicula panieri* Jadin and Vercammen-Grandjean, 1952, Ann. Soc. belge Med. trop., 32 : 609.*Trombicula (Microtrombicula) rodhaini* (Jadin and Vercammen-Grandjean).*Eutrombicula rodhaini* Jadin and Vercammen-Grandjean, 1952, loc. cit. : 601.

THE SPECIES-GROUPS.

1. The *mastomyia*-group.—This group was discussed by Vercammen-Grandjean and Jadin ('Rev. Zool. Bot. Afr.', 53 : 344). It is distinguished from the generally similar *panieri*-group by the following characters: eyes and the mastitarsala-III are absent, the sensillæ are likewise bifurcate or trifurcate but the proximal shafts are spiculate, not nude; both known species have 3 genualæ-I and 3 prongs to the palpal claws. One or two of the setæ on the palpal tarsus may appear nude (*e.g.* 5B.N instead of 6B). All legs are 7-segmented. Hosts are rodents.

There are at present only two species in this group, both Ethiopian :

Trombicula mastomyia Radford, 1942, 'Parasitology', 34 : 64.*Trombicula mastomyia mastomyia* Vercammen-Grandjean and Jadin, 1956, Rev. Zool. Bot. Afr., 53 : 345.*Trombicula (Trombicula) mastomyia* W. and F., 1952 : 67.*Trombicula giroudi* Andre, 1951, Bull. Soc. Path. exot., 44 : 218.*Trombicula mastomyia giroudi* Vercammen-Grandjean and Jadin, 1956, loc. cit. : 345.*Trombicula (Trombicula) giroudi* W. and F., 1952 : 65.*Trombicula mastomyia kivuensis* Vercammen-Grandjean and Jadin, 1956, loc. cit. : 346.

Trombicula quasigiroudi Jadin and Vercammen-Grandjean, 1954, 'Ann. Mus. Congo belg, Zool.', 1 : 196.

2. The *ugandae*-group.—*T. ugandae* is here chosen to represent this group only because it is one of the completely described larvæ in the group and because the name draws attention to an African origin. This group was referred to as a potential new genus by Vercammen-Grandjean and Brennan (1957). Over 15 new species in this group are being described, including a number of

nymphs. The *ugandae*-group differs from the preceding as follows : there are 2 (sometimes 3) genualae-I and at least 1 mastitarsala-I (which may bear a few barbs proximally) ; the setæ on the palpal femur and genu are usually strongly barbed ; there are 2 or 3 prongs to the palpal claw, eyes are usually 2 + 2, the sensillæ are ordinarily barbed and the shafts are not proximally spiculate, and the scuta are often obviously broader than deep. Hosts are rodents and sometimes birds and reptiles in the Ethiopian region. *Fonsecia* Rad., which appears to be particularly related to snakes in the Oriental region, is closely affiliated. Some species in the *ugandae*-group (e.g. *T. aenigma*) can be distinguished from the *laurencei*-group (*Eutrombicula*, subgenus *Squamicola* Audy and Vercammen-Grandjean) only by the presence of 6 barbed setæ on the palpal tarsus (tentacular formula 6B instead of 7BS), and the relationships require further investigation. There are unfortunately considerable difficulties in the way of using post-larval characters to guide one in the system of larval classification, but no doubt that guidance will be forthcoming.

The following 8 species are included in this group, all being Ethiopian :

Trombicula abyssinica Radford, 1946, 'Proc. Zool. Soc. Lond.', **116** : 590.

Trombicula (*Trombicula*) *abyssinica* W. and F., 1952 : 61.

Trombicula aenigma (Lawrence).

Eutrombicula aenigma Lawrence, 1949, Ann. Natal Mus., **11** : 447.

Trombicula (*Trombicula*) *aenigma* W. and F., 1952 : 62.

Trombicula boaedonia Jadin and Vercammen-Grandjean, 1952, 'Ann. Soc. belge Med. trop.', **32** : 630.

Trombicula ilesei (Radford).

Pentagonella ilesei Radford, 1948, Proc. Zool. Soc. Lond., **118** : 214.

Trombicula (*Trombicula*) *ilesei* W. and F., 1952 : 66.

Trombicula mini Vercammen-Grandjean and Brennan, 1957, 'Ann. ent. Soc. Amer.', **50** : 486.

Trombicula rossi Vercammen-Grandjean and Brennan, 1957, *loc. cit.*, p. 485.

Trombicula sicei André.

Thrombicula sicei André, 1951, Bull. Soc. Path. exot., **44** : 216.

Trombicula (*Trombicula*) *sicei* W. and F., 1952 : 70.

Trombicula ugandae Vercammen-Grandjean and Brennan, 1957, *loc. cit.*, p. 494.

SPECIES OF *Trombicula*, *incertae sedis*.

In addition to the two subgenera and the two species-groups, the following ungrouped species are of uncertain status, many of them probably not belonging properly to this genus.

Trombicula bruynoghei Jadin and Vercammen-Grandjean, 1952.
'Ann. Soc. belge Med. trop.', **32** : 618.

Trombicula centropodis Ewing, 1928, 'Proc. ent. Soc. Wash.', **30** : 78.
Trombicula (*Trombicula*) *centropodis* W. and F., 1952 : 63.

Trombicula claviglia Radford, 1948, 'Proc. Zool. Soc. Lond.', **118** : 213.
Trombicula (*Trombicula*) *claviglia* W. and F. 1952 : 64.

Trombicula claviglicola Lawrence, 1949, 'Ann. Natal Mus.', **11** : 410.
Trombicula (*Trombicula*) *claviglicola* W. and F., 1952 : 64.

Trombicula guineense (Bruyant and Joyaux).
Microthrombidium guineense Bruyant and Joyaux, 1913, Bull. Soc. Path. exot., **6** : 202.
Trombicula (*Trombicula*) *guineense* W. and F., 1952 : 65.

Trombicula nigeriensis Ewing, 1928, 'Proc. ent. Soc. Wash.', **30** : 77.
Trombicula (*Trombicula*) *nigeriensis* W. and F., 1952 : 68.

Trombicula rhodesiana Lawrence, 1949, 'Ann. Natal Mus.', **11** : 440.
Trombicula (*Trombicula*) *rhodesiana* W. and F., 1952 : 69.

Trombicula scapulosa André (adult).
Thrombicula scapulosa André, 1954, Bull. Mus. Hist. nat. Paris, **18** : 472.
Trombicula (*Trombicula*) *scapulosa* W. and F., 1952 : 70.

Trombicula sulae (Oudemans).
Microthrombidium sulae Oudemans, 1910, Ent. Ber. Amst., **3** : 85.
Trombicula (*Trombicula*) *sulae* W. and F., 1952 : 70.

Trombicula youhensis Abonnenc and Taufflieb, 1957,
'Bull. Soc. Path. exot.', **50** : 560.

SUMMARY.

The genus *Trombicula* is restricted to the subgenera *Trombicula* (at present with only one described species, the generic type) and *Microtrombicula* Ewing (= *panieri*-group), and two species-groups (*mastomyia*- and *ugandae*-groups). These account for a total of 27 species described from the Ethiopian region, with over 20 more species being described. *Trombicula* and *Microtrombicula* comprise mostly bat-chiggers.

In addition, at least 11 species of uncertain status from the Ethiopian region are left in this genus pending further studies.

The following, listed as subgenera of *Trombicula* by Wharton and Fuller (1952) or by later workers, are regarded by us as generically distinct from *Trombicula*: *Blankaartia* Ouds. (= *Tragardhula* Berl.), *Crotiscella* W. and F., *Euschongastoides* Loomis, *Leptotrombidium* Nagayo *et al.* (with *Trombiculindus* Rad. as a subgenus: Audy, 1959), *Miyatrombicula* Sasa *et al.*, *Neotrombicula* Ewing, *Toritrombicula* Sasa (= *Vorcana* Audy, synonym: Audy, 1959). *Fonsecia* Rad. is, however, akin to the *ugandae*-group and one of us (P. H. V.-G.) would include it in the genus *Trombicula* as here envisaged.

REFERENCE.

These are included with references to the second paper of this series.